REMARKS

Reconsideration and allowance of the present application based on the following remarks is respectfully requested.

Objection to the abstract

The abstract was objected to because of use of "means" and "said" and because it was not limited to a single paragraph. In light of the new abstract entered above, applicant respectfully requests that this objection be withdrawn.

Objection to claim 12

Claim 12 was objected to under Rule 75(c) as being of improper dependent form. Claim 12 having been rewritten above in independent form, applicant respectfully requests that this objection be withdrawn.

Rejection under 35 U.S.C. § 112

Claim 13 was rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification. In light of the following remarks, applicant respectfully requests that this rejection be withdrawn.

In rejecting this claim, the Examiner stated that "[t]he specification does not disclose anything related to a 'computer,' a 'computer program,' or a 'program code.'" Applicant respectfully notes that the title of the application as originally filed reads "LITHOGRAPHIC PROJECTION APPARATUS POSITIONING SYSTEM ... AND COMPUTER PROGRAM." Additionally, claim 13 was part of the disclosure as originally filed and therefore provides its own support. Moreover, the specification clearly states that the invention may be implemented using "control electronics or software" (see paragraphs 55 and 60). One of ordinary skill in the art would recognize that the term "software" commonly refers to a program or program code executable by a computer. Therefore, applicant respectfully submits that the specification as filed provides support for the subject matter of claim 13.

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<u>Rejection under 35 U.S.C. § 103</u>

Claims 1–13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bleijenberg (U.S. Patent No. 4,888,543) in view of Sperling et al. (U.S. Patent No. 5,815,246). In light of the following remarks, applicant respectfully requests that this rejection be withdrawn.

Claims 1 and 10–13 recite a positioning system comprising a stator and a translator. The positioning system includes a plurality of coils configured to induce movement of the translator in more than one degree of freedom. The plurality of coils is also configured to induce vibrations of the translator. Claims 1 and 10–13 also recite measurement of vibrations of the translator in more than one degree of freedom and determination of a phase relationship based on the measured vibrations.

The Office Action does not allege that Sperling teaches measurement of any vibration.

Bleijenberg discloses a linear motor that has a stator and a translator (Figure 1; col. 4, ll. 24–49). As shown in Figure 1 and described in the text, the translator of this motor is movable relative to the stator in only one degree of freedom (labeled as arrow 4; see also col. 4, ll. 26–28). Measurement of vibration for this translator is relatively easy, as translator vibration is induced only along the single degree of freedom (see bottom plot in Figure 5 and accompanying text at col. 7, ll. 15–18).

In comparison, claims 1 and 10–13 also recite a translator movable in more than one degree of freedom, measurement of vibrations of the translator in more than one degree of freedom, and determination of a phase relationship based on the measured vibrations. As discussed in, e.g., paragraphs 46–48 of the specification, the same energizing current can produce a movement of the translator in different degrees of freedom, depending upon the translator phase position. As the system of Bleijenberg only moves and measures in one degree of freedom, Bleijenberg cannot be said to teach or suggest **<u>measurement of vibrations of the translator in more than one degree of freedom</u>**. Moreover, as such measurement is not disclosed by Bleijenberg, this reference also cannot be said to disclose **<u>determination of a phase relationship based on the measured vibrations</u>**.

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New claims

New claims 14–23, 24–27, 28–32, 33–34, and 35–36 depend from claims 1, 10, 11, 12, and 13, respectively.

Claim 14 recites a vibration measurer configured to measure vibrations in at least two orthogonal directions. As noted above, the system of Bleijenberg only measures in one degree of freedom.

Claims 17 and 18 each recite a plurality of coils configured to receive an oscillating signal only through some of the coils. Bleijenberg does not disclose any such coil configuration.

Claim 20 recites that a spacing between a forward conductor and a return conductor of a coil is at least substantially equal to a distance between a first parallel line connecting the centers of adjacent magnets of a first orientation and a second parallel line connecting the centers of adjacent magnets of a second orientation. Bleijenberg does not disclose any such coil feature.

Claim 21 recites that a length of a forward conductor of a coil is substantially equal to an even multiple of a distance between a first parallel line connecting the centers of adjacent magnets of a first orientation and a second parallel line connecting the centers of adjacent magnets of a second orientation. Bleijenberg does not disclose any such coil feature.

Claim 22 recites a first oil oriented parallel to a second coil, wherein a forward conductor of the first coil is closer than a return conductor of the second coil than a forward conductor of the second coil. Bleijenberg does not disclose any such coil feature.

For at least the reasons noted above, applicant respectfully submits that new claims 14–36 are allowable over the art of record.

In view of the foregoing, the claims are now believed to be in form for allowance, and such action is hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to contact the undersigned at the telephone number listed below.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned **"Version with markings to show changes made"**.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,
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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Paragraph 0015 is changed as follows:

[EP-0 297 G43-A1] EP-0 297 642-A1 describes a method of alignment of a linear or rotary motor of the synchronous type in which the relations between the driving forces of the motor and the energizing currents in the phase windings are periodic functions of the rotor or translator position and that has an incremental encoder for measuring displacements of the rotor or translator. The method involves generating measuring currents in different phase windings in turn to produce vibration in the rotor or stator and determines the position of the rotor or translator from the amplitude of the induced vibrations.

Paragraph 0016 is changed as follows:

In an aspect of at least one embodiment of the present invention, there is provided a method of determining the initial position of the moving part of a planar motor in a lithographic projection apparatus.

IN THE CLAIMS:

1. (Amended) A lithographic projection apparatus comprising:

a radiation system to provide a projection beam of radiation;

a support structure to support patterning structure, the patterning structure serves to pattern the projection beam according to a desired pattern;

a substrate table to hold a substrate;

a positioning system to position at least one of said support structure and said substrate table, said positioning system comprising [a planar motor having] a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of [energizable] coils, [said

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coils when energized in turn with an oscillating signal causing vibrations of said translator] <u>said plurality of coils being configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, said plurality of coils being further configured to receive an oscillating signal to induce vibrations of said translator</u>, said vibrations having an amplitude less than the period of said periodic magnet structure;

a projection system to project the patterned beam onto a target portion of said substrate; and

a vibration measurer to measure [said] vibrations of said translator <u>in more than one degree of freedom</u> and to determine [the] <u>a</u> phase relationship between said translator and said stator on the basis of said measured vibrations.

10. (Amended) A positioning system to position an object, said positioning system comprising:

[a planar motor having] a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of [energizable] coils, [said coils energized in turn with an oscillating signal sufficient to cause vibrations of said translator] <u>said plurality of coils being configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, said plurality of coils being further configured to receive an oscillating signal to induce vibrations of said translator</u>, said vibrations having an amplitude less than the period of said periodic magnet structure; and

a vibration measurer to measure said vibrations of said translator <u>in more than one degree of freedom</u> and determine [the] <u>a</u> phase relationship between said translator and said stator on the basis of said measured vibrations.

11. (Amended) A device manufacturing method using a lithographic projection apparatus, the lithographic apparatus including a positioning system to position at least one of a support structure to support patterning structure and a substrate table, said positioning system comprising [a planar motor having] a stator and a translator, one of said stator and

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said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of [energizable] coils configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, the method comprising:

providing a substrate that is at least partially covered by a layer of radiation-sensitive material;

providing a projection beam of radiation using a radiation system;

using patterning structure to endow the projection beam with a pattern in its cross-section;

projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material;

[energizing a plurality of said coils in turn with] applying to a plurality of said coils an oscillating signal sufficient to cause vibrations of said translator in more than one degree of freedom, said vibrations having an amplitude less than the period of said periodic magnet structure;

measuring said vibrations of said translator in more than one degree of freedom; and

determining [the] a phase relationship between said translator and said stator on the basis of said measured vibrations.

12. (Amended) A device manufactured according to [the method of claim 11] a method using a lithographic projection apparatus, the lithographic apparatus including a positioning system to position at least one of a support structure to support patterning structure and a substrate table, said positioning system comprising a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of coils configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, the method comprising:

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<u>providing a substrate that is at least partially covered by a layer of radiation-sensitive material;</u>

<u>providing a projection beam of radiation using a radiation system;</u>

<u>using patterning structure to endow the projection beam with a pattern in its cross-section;</u>

<u>projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material;</u>

<u>applying to a plurality of said coils an oscillating signal sufficient to cause vibrations of said translator in more than one degree of freedom, said vibrations having an amplitude less than the period of said periodic magnet structure;</u>

<u>measuring said vibrations of said translator in more than one degree of freedom; and</u>

<u>determining a phase relationship between said translator and said stator on the basis of said measured vibrations</u>.

13. (Amended) A computer program to determine [the] <u>a</u> phase relationship of a stator and a translator in a lithographic projection apparatus, the lithographic projection apparatus including a positioning system to position at least one of a substrate table and a support structure to support patterning structure, said positioning system comprising [a planar motor having] a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of [energizable] coils <u>configured to receive a movement signal to induce movement of said translator in more than one degree of freedom</u>, the computer program comprising program code to, when executed on a computer, perform the method of:

[energizing a plurality of said coils in turn with] <u>applying to a plurality of said coils</u> an oscillating signal sufficient to cause vibrations of said translator <u>in more than one degree of freedom</u>, said vibrations having an amplitude less than the period of said periodic magnet structure;

measuring said vibrations of said translator <u>in more than one degree of freedom</u>; and

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determining [the] a phase relationship between said translator and said stator on the basis of said measured vibrations.

IN THE ABSTRACT OF THE DISCLOSURE:

The abstract is changed as follows:

A lithographic apparatus has a positioning system for positioning an object table[, said]. The positioning system [comprising] includes a planar motor having a stator and a translator, one [of said stator and said translator] comprising a periodic magnet structure and the other [of said stator and said translator] comprising a plurality of [energizable] coils. The phase relationship between the stator and translator [of the planar motor] is determined by energizing [a plurality of said energizable] at least some of the coils [in turn] with an oscillating signal sufficient to cause vibrations of [said] the translator [having an amplitude less than the period of said periodic magnet structure], measuring [said] the vibrations [of said translator], and determining the phase relationship between [said] the translator and [said] stator on the basis of [said] the measured vibrations.[

]Alternatively, the relationship between stator and translator [is] may be determined by [detecting means] detecting distinct optical marks on the periodic magnet array[. Control means determine the relationship between said translator and said stator on the basis of detected distinct optical marks].

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